Do Employee Commuter Benefits Reduce Vehicle Emissions and Fuel Consumption? Results of the Fall 2004 Best Workplaces for Commuters Survey

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ABSTRACT

A survey of firms recognized as Best Workplaces for Commuters (BWC) was conducted in the fall of 2004. The purpose of the survey was to determine the difference between the commuting patterns of employees receiving employee commuter benefits such as those offered by BWCs and those who do not and to estimate the resulting saving in trips, vehicle miles of travel (VMT), and emissions and fuel consumption. Employers recognized as BWCs in the Denver, Houston, San Francisco, and Washington DC metro areas were randomly sampled and recruited into the survey using a combination of telephone and email communications. The results of this survey indicate that where employers provide employees with incentives to commute by means other than driving alone, significant percentages of them take advantage of these benefits. Comprehensive benefit packages such as those enjoyed by commuters in the BWC group, with financial incentives, services (such as guaranteed ride home, carpool matching, etc.) and informational campaigns, appear to produce reductions of trips, VMT, pollutants, and fuel consumption of around 15 percent even under conservative assumptions. Benefits packages offering services and information, but not financial incentives, appear to produce reductions of around seven percent under conservative assumptions.

INTRODUCTION

Best Workplaces for Commuters (BWC) is a voluntary government-industry partnership sponsored by the United States Environmental Protection Agency (EPA) and the United States Department of Transportation (DOT) that began in May, 2001. Its goal is to reduce vehicle emissions and traffic congestion by encouraging employers to offer a comprehensive package of employee commuter benefits (subsidized transit or vanpool passes, liberal telework policies, supporting measures for carpooling or bicycling, etc.) as part of their employee benefit packages.

The BWC Survey was conducted in the fall of 2004. The purpose of the survey was to determine the difference between the commuting patterns of employees receiving BWC commuter benefits and those who do not and to estimate the resulting saving in trips, vehicle miles of travel (VMT), and emissions and fuel consumption. Employers recognized as BWCs in the Denver, Houston, San Francisco, and Washington DC metro areas were randomly sampled and recruited into the survey using a combination of telephone and email communications. These four metro areas were chosen for the survey because they were large urban areas that each had substantial numbers of BWCs, and transit systems of differing ages and degrees of coverage. One indicator of the variability of commuting conditions in the four selected areas is the Census data on drive-alone rates for workers in the zip codes in which BWC employers are located: 74% for Denver, 75.2% for Houston, 68.4% for San Francisco, and 55.4% for Washington, DC. As of September 30, 2004, 617,391 out of 2,024,906 commuters employed at BWC worksites nationwide were in these four urban areas, approximately 30 percent of the total.

Employee Transportation Coordinators (ETCs) at the surveyed firms were provided with a questionnaire to document the status of the BWC program at each site as well as locational characteristics of the worksites. In addition, ETCs were provided with a company-wide identification number and password, and asked to distribute them to all employees in order to allow them to participate in the Internet-based survey. The employee survey obtained details about the current and prior commute modes, distance to work (in miles and time), and other commute and demographic characteristics.

The survey was administered via the internet at BWC worksites to two groups of respondents: those who were eligible for BWC level commuter benefits (referred to in this report as the "BWC" group) and those not eligible for the benefits because they were contractors, temporary employees or others ineligible for company benefits (the "Reference" group). The Survey was administered at each selected worksite from September 13 through October 30, 2004. Of the 6,708 employees, from 64 employers, who participated in the survey, 6075 were in the BWC group and 633 in the Reference group.

The Reference group was established initially as a control group representing employees in the same transportation environment as BWC, but ineligible for BWC benefits, and therefore, whose travel choices are unaffected by BWC benefits. As it turned out, respondents in the Reference group were exposed to the same services, marketing programs and corporate focus on alternative modes. Most (55 percent) indicated that they received information on ways to get to work other than riding alone, and many (37.6 percent) indicated that they were able to take advantage of some of the employer-provided services such as carpool matching and bicycle

facilities. As a result, their responses are used as a measure of the incremental change associated with the provision of BWC level commuter benefits at a worksite where a lesser package of commuter benefits are offered.

The results for both the BWC and Reference groups are presented throughout this analysis, and are compared with commuting patterns of the at-large population working in the same zip codes as the BWC worksites participating in this survey. To do this, virtual groups are created of the same sizes and with the same average trips distances as the BWC and Reference groups, but their mode distributions are those obtained from the 2000 Census for people working in the same zip codes as the surveyed worksites. Census mode shares were mapped onto data from the survey respondents, such as trip distance and carpool occupancy to obtain an estimate of what the travel activity for the BWC and Reference groups would have been had they traveled to work by the same modes as all others working in the same zip codes. Hereafter all references to zip codes refer to zip codes of workplace, not of residence.

These groups ("Census" groups) serve as control groups and provide an independent estimate of work-related travel without the BWC marketing to which the Reference group has been exposed. In sum, the three groups can be defined as:

- BWC Group – Employees eligible for comprehensive commuter benefits and general marketing information meeting the BWC National Standard of Excellence from employers participating in the BWC program
- Reference Group – Employees who are not eligible for BWC benefits but who have been exposed specifically to BWC marketing messages and in some cases access to BWC support benefits
- Census Groups – Characterized by average mode share distribution for all employees in the surveyed zip codes, regardless of commuter benefits and marketing messages. This general data was used to provide a "natural" distribution of survey responses for both the BWC and Reference groups. Because it is based on Census data, this group includes individuals receiving some level of commuter benefits, hence, it is not a pure non-doer group.

The following sections describe the steps by which the emissions reductions and energy savings are calculated in the order in which they are performed. First, the mode share changes are determined. These determine the changes in trip-making, which, in turn, determine the changes in vehicle miles traveled (VMT). Changes in vehicle emissions and fuel consumption are then calculated from the changes in trips and VMT.

MODE SHARE CHANGES

Daily Mode Distributions

Respondents were asked what mode they used to travel to work for each day of the preceding week. Results were as shown in Table 1. Note that respondents' days off were omitted from the Average Daily Share calculations. That is, the mode share calculations are based only on the responses of those working that day.

Dominant Mode Distributions

In order to compare the mode shares reported in the BWC survey with those Census group, which are based on commute modes reported in the long form of the US census, a methodological difference had to be overcome. The US Census long form allowed respondents to report only one mode: that used for the majority of their travel to work. The BWC survey asked for mode used on each day of the week prior. Respondents could only choose one mode for each day, but as summed in the tables above, could report multiple modes used throughout the week. Therefore, while the mode usage reported in the BWC survey can be considered a more accurate depiction of the variations in mode usage throughout a given work week, a direct comparison of the BWC and Census groups required the derivation of a single mode for each respondent in the BWC group.

The criteria for developing this dominant mode were as follows:

1. If the respondent reported the same travel mode for all days traveled to work, that mode became the dominant mode.
2. If the respondent reported using more than one mode throughout the week, then the mode reported the majority of times became the dominant mode.
3. If the respondent reported using more than one mode, but the mode usage was equal (for example, traveled to work four days and used Mode A 2 days and Mode B 2 days), the dominant mode was the one reported first.

Table 2 shows the distributions of dominant mode vs. average daily mode for the BWC and Reference groups, and the Census figures for their zip codes. For each group, the first column (Avg. Daily Share) shows the proportions only for mode usage reported on a work day (which for most respondents was 4 or 5 days of the week). The second column in each group (Dominant) is the dominant mode distribution, calculated as noted above. With the exception of teleworking, the Dominant Mode mirrors the Average Daily Share fairly consistently.

One effect of collapsing the average daily mode distributions to dominant distributions is that the reported incidence of teleworking is reduced from 3 percent and 2.5 percent for the BWC and Reference groups, respectively, to 1.1 percent for both. This way of determining mode shares also fails to note transit use and carpooling by workers who use these modes to finish a trip, of which the longer portion is driven alone and so may underestimate the effectiveness of measures to boost use of these modes. Finally, because vanpooling is not a category in the Census mode shares, it was combined with carpooling for this survey. So these results may understate the effectiveness of a number of transportation demand management (TDM) measures.

CHANGES IN TRIP MAKING

Person Trips

Table 3 shows the numbers of one-way trips reported in the survey by dominant mode and their percentages of the total number of daily work trips for their respective groups. In this analysis it is assumed that each person's trip to work and return trip home are by the same mode. Note that these are counts of individuals traveling by each mode, not of vehicles. The table shows the number of trips reported by the BWC group (receiving commuter benefits), the Reference group (not eligible for BWC benefits), and the survey results generalized using census data. The census groups indicate the number of trips that would be generated if the BWC and Reference groups traveled to work with the same mode distributions as the working population at large in the areas where they work.

Vehicle Trips

In order to calculate emissions impacts, we have to estimate the number of vehicle trips resulting from the reported numbers of person trips. Two somewhat simplifying assumptions were made. First, it was assumed that each person that traveled to work by a particular mode used that same mode for the return trip home. Second, the determination of change in vehicle trips focused only on those trips made by auto, either driving alone or carpooling. This was done because we assume that the additional number of transit riders due to the provision of BWC benefits does not result in significant changes in the number of transit vehicles and routes, while walking, bicycling and telecommuting contribute no emissions at all.

Table 4 shows the number of vehicle trips estimated for those driving alone and carpooling. The number of drive-alone vehicle trips is the same as the number of drive-alone person trips since each person occupies a vehicle. For carpools, vehicle trips are person trips divided by the number of persons per vehicle. Average vehicle occupancies for carpools were reported to be 2.99 for the BWC group, and 2.48 for the Reference group. If all those riding together in carpools were co-workers traveling together to the same worksites, vehicle trips would be calculated simply by dividing person trips by vehicle occupancy. However, there is evidence that some carpooling is done by members of the same household traveling together, being dropped off at different locations. For the purpose of determining the effect of vehicle trips to and from a given worksite, carpool drivers who drop their passengers off at different locations before arriving alone at work, generate as many vehicle trips for that worksite as they would had they driven their entire trip to work alone.

The analysis in "Commuting in America II," (Pisarski, et.al., 1996), indicated that 60 percent of all carpooling is by members of the same household traveling together, sometimes called "fam-pooling." Additional data points on the prevalence of this kind of carpooling are hard to find. However, analyses done for municipal governments in Florida indicate that around 50 percent of carpooling in those areas is fam-pooling (Winters, 2005).

Two different estimates of the effect of carpooling on vehicle occupancy are offered due to the uncertainty over the number carpool riders traveling to the same workplace as the survey

participants. Survey participants were not asked whether those with whom they shared rides (if they did) were co-workers or others. This would be a worthwhile question to ask on a future survey. Because most BWC firms provide some support for carpooling, it is reasonable to assume that the percentage of carpools made up of coworkers is higher than the data cited above suggest. Two sets of trip numbers were calculated based on the assumptions that 50 percent of all carpools in this survey were made up of co-workers, and that 75 percent were. The emission reduction calculations were based on these two sets of assumptions. It is unlikely that all (100 percent) carpoolers in this survey carpooled only with co-workers, hence this scenario was not considered.

CHANGES IN VEHICLES MILES TRAVELED

The second element from the 2004 survey important in determining the level of emissions reduction attributable to the BWC program is vehicle miles traveled. The survey specifically asked respondents about the length of their trips to work. The responses for each respondent group, is shown in Table 5.

The survey question obtained distance only in terms of the categories shown above. In order to calculate VMT, it was necessary to determine the average distance traveled for each category. This was done by analyzing reported trip distances in the 2001 National Household Travel Survey and finding the average distance for each category. This was done to take into account the fact that travel usually cannot be done in a straight line manner. These results are summarized in Table 6. The average trip distances were then used in the emissions and fuel consumption calculations.

CHANGES IN EMISSIONS AND FUEL CONSUMPTION

With the estimates in changes in trips and VMT, and emission factors from MOBILE6.2, we are-able to obtain estimates of emission reductions and fuel savings resulting from employee participation in the Best Workplaces for Commuters program. MOBILE6.2 is the latest version of EPA's mobile source emission factor model. It calculates basic emission rates for motor vehicles based upon a large number of variables, including the age distribution and vehicle type distribution of the vehicle fleet, control programs such as Inspection and Maintenance or Reformulated Fuel, roadway facility type and others.

Changes in the emissions of volatile organic compounds (VOC), nitrogen oxides (NOx), carbon monoxide (CO), and carbon dioxide (CO2) were calculated from MOBILE6.2 emission factors. Gasoline consumption changes were calculated from the changes in CO2 emissions.

MOBILE6.2 scenarios were run to simulate conditions on September 30, 2004, which fell about three weeks into the survey period. Default national vehicle age and vehicle type distributions were assumed. Several MOBILE 6.2 model runs were done to reflect-different temperature ranges, use of conventional or reformulated gasoline, and basic or enhanced inspection and maintenance (I/M). Changes in these parameters produce changes in the emission rates of VOC, NOx, and CO, though not of CO2. In this analysis, the vehicles were assumed to be all light duty vehicles and light duty trucks.

Based on a preliminary analysis, a modeling case of conventional gasoline, daily temperatures ranging from 65 to 85 degrees Fahrenheit, and enhanced I/M was used to represent the low end of vehicle emission rates and hence, emission changes from the BWC program (if vehicle emission rates are low, changing the rates of trips and VMT changes total emissions less than if emission rates are high), while a case of conventional gasoline, daily temperature ranging from 75 to 95 degrees and basic I/M was used to represent the high end of emissions rates and changes from the BWC program (all scenarios using reformulated gasoline fell in the middle). All emission benefits reported in Tables 7, 8 and 9 are annual figures.

Changes were calculated based on comparisons of the BWC group with the Census, the BWC group with the Reference group, and the Reference group with the Census. All three of these comparisons were made under two scenarios reflecting the two different assumptions made about car pooling in the section on trip changes and the two MOBILE modeling cases discussed previously. Finally, the benefits are presented at three scales of analysis: changes at the survey level, survey findings normalized to the number of BWC employees in the four urban areas surveyed (617,391, as of September 30, 2004), and survey findings normalized to the number of BWC employees across the country on September 30, 2004 (approximately 2 million).

Comparison of the BWC Group to the Census

The Census group, to which the data from the BWC group is compared, is a virtual group with the same number of commuters, having the same average trip length and carpool occupancy as the BWC group. The only difference between the two groups is in the mode shares, and resulting numbers of trips. The results are summarized in Table 7. Because the only difference between the two groups is numbers of trips, the percentage reduction for trips, VMT, gasoline consumption, and all pollutants is the same within a scenario. For the scenario in which 75 percent of carpoolers are co-workers, traffic emissions and gasoline are reduced by almost 17 percent. When we assume that 50 percent of carpoolers are coworkers we get overall reductions of around 15 percent.

Comparison of the BWC Group to the Reference

The Reference group was comprised of employees at the same worksites as the BWC employees, but who worked as contractors, temporary employees, or in other categories that made them ineligible for the full package of benefits available to the BWC employees. This comparison gives us a rough estimate of the difference between the benefits attributable to a comprehensive package of commuter benefits, meeting the BWC Standard of Excellence, and a more modest package featuring primarily services, information, and encouragement. The Reference group was much smaller than the BWC group so for comparison purposes it was weighted to the same size. The BWC group and the Reference had different average trip lengths and carpool occupancies, whereas the Census group was assumed to have the same average trip length and carpool occupancy as the BWC group with only the mode shares, and as a result, the numbers of trips differing between the two groups. Because of this we do not see the same percentage reduction for everything within each scenario as we saw in the comparison of the BWC group to the Census group. This is because the contribution of start and running emissions

for each pollutant is different under different scenarios except for CO2 which has no start component in MOBILE 6.2.

The results of this comparison are summarized in Table 8. For the scenario where 75 percent of carpoolers are co-workers we get a reduction in trips of 11 percent while the reductions in VMT, emissions and gasoline consumption range from almost five to almost six percent. The benefits are less than a percent lower in the scenario where 50 percent of carpoolers are coworkers.

Comparison of the Reference Group to Census

Because the Reference group consisted of employees affected by the BWC program, even though they were not eligible for the full package of benefits, the degree to which their use of commute alternatives is greater than that of the general population is also a benefit that can be attributed to the BWC program. To estimate these benefits a virtual group based on Census mode shares is again created, this time of the same size, and with the same average trip distance and carpool occupancy as the Reference group. Here again we consider two scenarios with the same two assumptions about the percentage of carpoolers traveling together to the same worksite as were used in the previous analyses. The reductions are shown in Table 9, and are about eight percent for all reductions where 75 percent of carpoolers are assumed to be coworkers, and around seven percent where 50 percent of carpoolers are assume to be coworkers.

We also normalize these benefits to the size of the entire program as it was on September 30, 2004. EPA has an actual count of the number of employees covered by the full package of benefits at BWC worksites. However, it does not have a similar count of the number of employees at those worksites nationwide such as those in the Reference group, ineligible for the full package of benefits, but still affected by the marketing campaign and able to use some of the services and facilities available to BWC employees. For the purposes of this analysis, these employees are assumed to be present across the program in the same proportion to BWC employees as they were found in the survey.

CONCLUSION AND NEXT STEPS

The results of this survey indicate that where employers provide employees with incentives to commute by means other than driving alone, significant percentages of them take advantage of these benefits. Comprehensive benefit packages such as those enjoyed by commuter in the BWC group, with financial incentives, services (such as guaranteed ride home, carpool matching, etc.) and informational campaigns, appear to produce reductions of trips, VMT, pollutants, and fuel consumption of around 15 percent even under conservative assumptions. Benefits packages offering only services and information appear to produce reductions of around seven percent under conservative assumptions.

EPA's purpose in this survey is to evaluate the effectiveness, not only of commuter benefits generally, but of the Best Workplaces for Commuters initiative, in particular. EPA regards this survey as a first step. While the results are encouraging, a couple of limitations should be noted.

First, this survey was limited to four urban areas whereas employers across the country have been recognized as Best Workplaces for Commuters. EPA hopes to conduct a broader survey to verify the program-wide estimates offered in Tables 7 through 9.

Second, while 6,708 is a large number of responses, the sampled firms had a total of 43,182 employees, meaning the overall response rate was 15 percent. The fact that this survey was conducted only via the internet may have made it difficult for many employees to participate at some firms. This raises a concern about potential response bias. One method often used to detect response bias is to compare the responses of early responders with those who responded after reminders were sent. The responses of the late responders are thought to be an indication of how non-responders would have responded. An analysis of the responses of early and late responders to this survey found no differences between their choices of commute modes. EPA will explore ways to increase responses in any future survey, such using more than one way of delivering the questionnaire.

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TABLE 1 – Daily Mode Shares Reported from Survey

Mode Used	Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Total	Avg. Daily Share
BWC Group									
Car - SOV	2836	3005	3016	3045	2686	210	181	14979	51.1%
Car – not SOV	977	1026	1043	1034	880	57	44	5061	17.3%
Bus	676	724	697	693	600	13	11	3414	11.7%
Commuter Rail	663	760	744	731	629	24	21	3572	12.2%
Bicycle or walked	198	215	208	200	167	14	12	1014	3.5%
Other method	64	79	65	69	70	6	8	361	1.2%
Worked at home	119	100	143	120	235	95	81	893	3.0%
Comp Schd/Day Off	62	11	13	18	377	127	136	744	
Regular Day Off	476	150	142	160	427	5524	5575	12454	
Total	6071	6071	6071	6071	6071	6070	6069	42494	100.0%
Reference Group									
Car - SOV	335	352	367	355	337	30	24	1800	59.1%
Car – not SOV	92	90	95	86	79	7	2	451	14.8%
Bus	66	72	72	68	62	3	3	346	11.4%
Commuter Rail	44	45	51	44	47	2	1	234	7.7%
Bicycle or walked	22	22	19	23	19	3	1	109	3.6%
Other method	4	6	6	5	8	1	1	31	1.0%
Worked at home	8	12	8	12	14	13	8	75	2.5%
Comp Schd/Day Off	8	2	2	2	12	12	13	51	
Regular Day Off	54	31	13	38	55	562	580	1333	
Total	633	632	633	633	633	633	633	4430	100.0%

TABLE 2 – Comparison of Mode Assignments

Mode Used	BWC		Reference		Census
	Avg. Daily Share	Dominant Share	Avg. Daily Share	Dominant Share	Dominant Share
Car – SOV	51.1%	52.1%	59.1%	59.6%	66.8%
Car – not SOV	17.3%	17.8%	14.8%	14.8%	13.8%
Bus	11.7%	12.0%	11.4%	11.8%	11.4% (all Transit)
Commuter Rail	12.2%	12.5%	7.7%	8.5%	
Bicycle or walked	3.5%	3.3%	3.6%	3.5%	3.8%
Other method	1.2%	1.1%	1.0%	.6%	1.0%
Worked at home	3.0%	1.1%	2.5%	1.1%	3.2%
Total	100.0%	100%	100.0%	100%	

TABLE 3 Current One-Way Person Trips Reported in Survey

Current One-Way Trips	BWC		Reference		Census		
					BWC	Reference	Percent
Drive Alone	3163	52.7%	377	60.2%	4013	418	66.8%
Carpool	1081	18%	94	15%	846	88	14.1%
Transit	1492	24.9%	129	20.6%	907	95	15.1%
Walk/Bike	203	3.4%	22	3.5%	238	25	4%
Other	65	1.1$	4	0.6%	0	0	0%
Total	6004		626		6004	626	

TABLE 4 Commute Vehicle Trips Reported in Survey

Vehicle Trips	BWC		Reference		Census (BWC)		Census (Reference)	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
If 75 percent of carpoolers travel to the same worksites								
Drive Alone	3163	87%	377	88%	4013	91%	418	90%
Carpool	482	13%	51	12%	377	9%	47	10%
Total	3645		428		4390		465	
If 50 percent of carpoolers travel to the same worksites								
Drive Alone	3163	81%	377	83%	4013	88%	418	85%
Carpool	723	19%	76	17%	566	12%	71	15%
Total	3886		453		4579		489	

TABLE 5: Reported Trip Distances

How long is your trip to work?	BWC (n=6071)	Reference (n=633)
Distance for all Modes		
< 2 miles	5.2%	6.0%
2-5 miles	10.7%	14.2%
6-15 miles	27.5%	27.5%
16-25 miles	26.5%	25.4%
26-40 miles	20.2%	18.8%
> 40 miles	9.9%	8.1%
Total	100.0%	100.0%
Distances for Drive-alone and Carpool Only		
< 2 miles	3.7%	4.0%
2-5 miles	11.2%	14.9%
6-15 miles	28.6%	29.1%
16-25 miles	27.5%	25.3%
26-40 miles	19.6%	18.7%
> 40 miles	9.5%	8.1%
Total	100.0%	100.0%

TABLE 6 Calculated Trip Distances (Only Drive Alone and Carpool)

How long is your trip to work?	Avg Miles	BWC Miles	Reference miles
< 2 miles	0.62	98.58	11.78
2-5 miles	3.53	1673.22	247.1
6-15 miles	10.31	12495.72	1412.47
16-25 miles	20.73	24150.45	2466.87
26-40 miles	31.64	26324.48	2784.32
> 40 miles	59.68	23991.36	2267.84
Total		88,733.81	9,190.38
Average Trip Distance		20.91	19.51

TABLE 7 Comparison of BWC Group to Census – Emissions, Traffic, and Energy Benefits

	Benefit	Percent Change	Survey Level	Four Areas (617,391)	Per 2 Million Commuters
If 75% of Carpoolers Travel to the Same Worksite	CO2 (metric tons)	16.97%	3,152	320,339	1,037,720
	Trips	16.97%	357,699	36,352,287	117,760,987
	VMT	16.97%	7,479,486	760,126,313	2,462,382,229
	Gasoline	16.97%	358,199	36,403,099	117,925,589
	Low Change Scenario				
	VOC (tons)	16.97%	4.92	501	1,621
	NOx (tons)	16.97%	8.46	860	2,785
	CO (tons)	16.97%	147.75	15,015	48,641
	High Change Scenario				
	VOC (tons)	16.97%	5.45	554	1,795
	NOx (tons)	16.97%	8.47	861	2,790
	CO (tons)	16.97%	196.29	19,949	64,624
If 50% of Carpoolers Travel to the Same Worksite	CO2 (metric tons)	15.13%	2,930	297,816	964,755
	Trips	15.13%	332,548	33,796,288	109,480,986
	VMT	15.13%	6,953,589	706,680,376	2,289,247,417
	Gasoline	15.13%	333,013	33,843,527	109,634,015
	Low Change Scenario				
	VOC (tons)	15.13%	4.58	465	1,507
	NOx (tons)	15.13%	7.86	799	2,589
	CO (tons)	15.13%	137.36	13,960	45,221
	High Change Scenario				
	VOC (tons)	15.13%	5.07	515	1,668
	NOx (tons)	15.13%	7.88	801	2,594
	CO (tons)	15.13%	182.49	18,546	60,080

TABLE 8 Comparison of BWC and Reference Groups – Emissions, Traffic, and Energy Benefits

	Benefit	Percent Change	Survey Level	Four Areas (617,391)	Per 2 Million Commuters
If 75% of Carpoolers Travel to the Same Worksite	CO2 (metric tons)	4.74%	768	78,014	252,720
	Trips	11.16%	219,885	22,346,530	72,390,204
	VMT	4.79%	1,840,487	187,045,253	605,921,540
	Gasoline	4.74%	87,234	8,865,403	28,718,924
	Low Change Scenario				
	VOC (tons)	5.93%	1.52	501	500
	NOx (tons)	5.04%	2.20	860	723
	CO (tons)	5.48%	41.88	15,015	13,789
	High Change Scenario				
	VOC (tons)	5.72%	1.62	554	532
	NOx (tons)	5.02%	2.19	861	721
	CO (tons)	5.19%	53	19,949	17,318
If 50% of Carpoolers Travel to the Same Worksite	CO2 (metric tons)	4.11%	705	71,623	232,020
	Trips	10.58%	220,597	22,418,881	72,624,579
	VMT	4.16%	1,692,407	171,996,174	557,170,979
	Gasoline	4.11%	80,088	8,139,231	26,366,536
	Low Change Scenario				
	VOC (tons)	5.30%	1.44	146	473
	NOx (tons)	4.41%	2.03	207	670
	CO (tons)	4.85%	39.29	3,993	12,934
	High Change Scenario				
	VOC (tons)	5.09%	1.53	155	502
	NOx (tons)	4.39%	2.03	206	668
	CO (tons)	4.57%	49	4,977	16,122

TABLE 9 Comparison of Reference Group to Census – Emissions, Traffic, and Energy Benefits

	Benefit	Percent Change	Survey Level	Four Areas (617,391)	Per 2 Million Commuters
If 75% of Carpoolers Travel to the Same Worksite	CO2 (metric tons)	8.12%	247	25,063	81,190
	Trips	8.12%	18,132	1,842,682	5,969,255
	VMT	8.12%	353,748	35,950,731	116,460,170
	Gasoline	8.12%	28,025	2,848,145	9,226,389
	Low Change Scenario				
	VOC (tons)	8.12%	0.42	42	137
	NOx (tons)	8.12%	0.66	67	219
	CO (tons)	8.12%	11.33	1,151	3,729
	High Change Scenario				
	VOC (tons)	8.12%	0.45	46	150
	NOx (tons)	8.12%	0.66	67	216
	CO (tons)	8.12%	14.66	1,490	4,826
If 50% of Carpoolers Travel to the Same Worksite	CO2 (metric tons)	7.40%	236	23,993	77,724
	Trips	7.40%	17,357	1,764,002	5,714,377
	VMT	7.40%	338,643	34,415,687	111,487,490
	Gasoline	7.40%	26,829	2,726,533	8,832,436
	Low Change Scenario				
	VOC (tons)	7.40%	0.40	40	131
	NOx (tons)	7.40%	0.64	65	209
	CO (tons)	7.40%	10.84	1,102	3,570
	High Change Scenario				
	VOC (tons)	7.40%	0.44	44	143
	NOx (tons)	7.40%	0.63	64	207
	CO (tons)	7.40%	14.03	1,426	4,620